Soil Treatment to Remove Uranium and Related Mixed Radioactive Heavy Metal Contamination

Developer: Atomic Energy of Canada, Ltd.
Contract Number: DE-FC21-92MC28245
Crosscutting Area: N/A

Subsurface Contaminants FOCUS AREA

Problem:

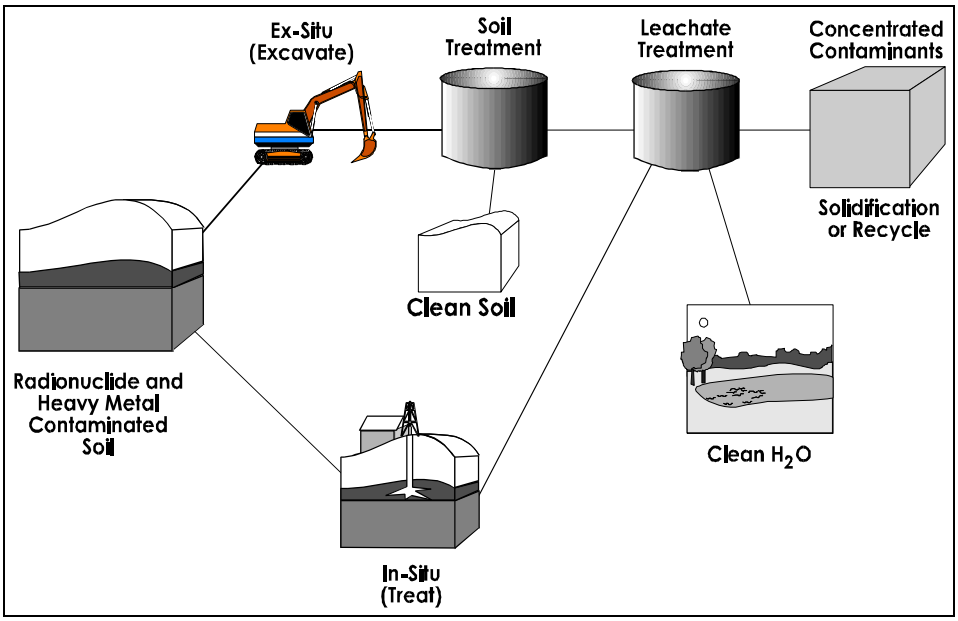
Past and current soil remediation technologies have been directed towards either ex situ or in situ processing for soil treatment. Contaminated soils may contain a variety of radionuclides and heavy metals which require different remediation techniques. Current technologies are very expensive and complex, and frequently generate secondary wastes.

Solution:

Develop an integrated approach using in situ and ex situ soil treatment technology that includes several innovative techniques such as chelation-flotation, ultrasonic chemical leaching and leaching treatment by precipitation, ion scavenging, microfiltration and filter pressing operations. This technology is intended to remove uranium from soil to an acceptable residual level of less than 35 pCi/g. The process is designed to provide clean soil, dischargeable water, and a concentrate that can be recovered and recycled or solidified for future disposal.

Benefits:

- Selective removal of a variety of radioactive and heavy metal soil contaminants
- Preferential enhancement for efficient removal of soil contaminants
- Flexible process components provide adaptability to a broad range of contaminants and soil types
- Ex-situ process components designed for mobility to permit use at multiple locations
- Potential large cost and time savings from: treatment of a variety of contaminants, process flexibility, and minimal secondary wastes



Technology:

The technology development involved the use of chelation-flotation, chemical leaching and ultrasonic-aided leaching in conjunction with cross-flow microfiltration and filter pressing steps. The project was composed of experimental and analysis effort in five distinct tasks.

In Task 1, different pre-experimental activities were performed: environmental assessment of the project for NEPA approval, selection and acquisition of contaminated soil samples, and implementation of a quality assurance program.

In Task 2, bench-scale soil treatment studies were conducted. The activities included: selection of cost-effective leachant(s); contaminant leaching kinetic studies; cost-effective chelating agent selection; determination of flotation conditions; selection of precipitation agent(s) and processing conditions; tests for establishing waste soil and leachate volume reductions; solidification/leach tests on secondary wastes; and an evaluation of concentrated uranium waste utilizations. Task 2 concluded with a preliminary integrated flowsheet design and a topical report.

Task 3 involved pilot-scale studies on specific components of the process developed in Task 2. The effectiveness of the process together with key design parameters were determined and reported in a Task 3 topical report.

In Task 4, in situ field studies were performed at the developer's Chalk River Laboratories site. The tests focused on the effectiveness of the leachant delivered to all parts of the contaminated soil block being treated and the leachant effectiveness to remove gamma- and beta-emitting radioisotopes, actinides, and heavy metals. A summary of test results was issued in a topical report.

In Task 5, fully integrated process flowsheets for the in situ and ex situ soil treatments were designed and preliminary engineering cost estimates were prepared. A final project report was prepared describing the complete results of the technology development study, and plans for possible future work.

Project Conclusion:

The AECL Cooperative Agreement expired in April 1996, and the final report was completed and submitted in July 1996. The project was successfully completed within cost and met all project goals, objectives, and success criteria as outlined in the contractual statement of work and the original technical proposal. Uranium from the Fernald soil was remediated below the established target value of 35 pCi/g.

AECL developed the integrated ex-situ soil treatment flow-scheme and designed a plant to process the contaminated soil at a rate of 20 tons per hour, and prepared a preliminary cost estimate of the soil treatment costs. The combined cost of soil leaching and leachate treatment was estimated to be $340 per ton of treated soil (DOE/Fernald soil). The estimated cost included all operating and capital depreciation costs for a plant life of 5 years. The cost estimate also assumed the reuse of the recovered uranium from the soil treatment at an existing uranium milling operation located in Canada.

The limited field study involving in-situ leaching of Chalk River soil compared favorably with the results obtained from the bench-scale soil column leaching and pilot-scale ex-situ soil leaching test results. The field test was successful in demonstrating that strontium-90 (^{90}Sr)contained in sandy soils can be mobilized easily using dilute acid as leachant. The study demonstrated the utility and practicality of decontaminating aquifers containing ^{90}Sr.

Contacts:

Atomic Energy of Canada Limited (AECL) conducts research and development work in the nuclear field and particularly in radioactive waste management. AECL places a strong emphasis on the application and commercialization of the technologies developed from this research and development. For information on this project, the contractor contact is:

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